From Lamarck and Humboldt to Lysenko: Critique of Darwinist Historiography and Recovery of the Systemic View of Life

Abstract

Traditional historiography of biology has constructed a linear narrative that consecrates Charles Darwin as the sole founder of modern evolutionary theory, relegating figures such as Jean-Baptiste Lamarck and Alexander von Humboldt to the margins of anecdote or error, and demonizing Trofim Lysenko as a pseudoscientist without examining his intuitions. This article proposes a critical revision of this narrative, arguing that (1) Lamarck formulated the first coherent evolutionary theory with a scientific foundation fifty years before Darwin; (2) Humboldt developed an ecological and systemic vision of nature that anticipated current systems biology and is now resurging in the science of the Anthropocene; (3) Neo-Darwinism triumphed historically not only because of its empirical evidence but also because of its compatibility with the dominant capitalist and industrial ideology; (4) Contemporary epigenetics and developmental biology have refuted the reductionist core of Darwinian theory, partially vindicating Lamarckian intuitions about plasticity and environmental inheritance; and (5) The Lysenko case reveals a double historiographical standard in the evaluation of scientific figures, where political judgment has replaced biological analysis. It is concluded that 21st-century biology must abandon the teleological language of "natural selection" and move toward an extended evolutionary synthesis based on self-organization, phenotypic plasticity, niche construction, and epigenetic inheritance.

Keywords: Lamarck, Humboldt, Lysenko, evolution, epigenetics, self-organization, niche construction, history of biology.

1. Introduction

20th-century evolutionary biology consolidated itself around a narrative that presented the modern synthesis—the fusion of Mendelian genetics with Darwinian natural selection—as the inevitable culmination of biological thought. In this narrative, Charles Darwin occupies the place of undisputed founder; Jean-Baptiste Lamarck appears as a misguided precursor, and figures such as Alexander von Humboldt are relegated to the status of "descriptive naturalists" lacking theoretical rigor. Trofim Lysenko, for his part, has been turned into the

archetype of the pseudoscientist, without his agronomic theses being seriously examined.

However, discoveries of the last two decades—epigenetics, phenotypic plasticity, horizontal gene transfer, symbiogenesis, niche construction—have eroded the foundations of gene-centric reductionism. The decoding of the human genome, far from confirming genetic determinism, revealed a regulatory complexity that far exceeds the linear "one gene, one protein, one trait" model. In this context, the ideas of Lamarck, Humboldt, and even Lysenko re-emerge not as historical curiosities but as precursors of a systemic, plastic, and ecological view of life that contemporary biology is rediscovering.

This article proposes a critical revision of evolutionary historiography, integrating the scientific, philosophical, and ideological dimensions that determined the triumph of Neo-Darwinism and the marginalization of alternative theories. It is argued that 21st-century biology should not choose between Lamarck and Darwin, but rather transcend both frameworks through a synthesis that recognizes the complexity of evolutionary processes.

2. Lamarck: The First Scientific Evolutionary Theory

Jean-Baptiste Lamarck (1744–1829) formulated in 1809, in his *Philosophie zoologique*, the first coherent theory of the transformation of species. His fundamental contributions include:

1. The coining of the term "biology" (1802) to designate the science of living beings.
2. Transformism: the idea that species are not fixed but change over time and descend from one another.
3. The law of use and disuse: organs develop or atrophy according to their functional use.
4. Inheritance of acquired characteristics: changes induced by the environment and behavior are transmitted to offspring.
5. Spontaneous generation as the continuous origin of life: simple microscopic organisms arise from inert matter and evolve toward more complex forms.
6. An internal tendency toward complexity: an immanent principle driving the increasing organization of living beings.

Although the hereditary mechanism proposed by Lamarck proved incorrect in light of genetics, his conceptual framework contained elements that are now being vindicated:

• Phenotypic plasticity as an evolutionary driver.
• The influence of the environment on the expression and transmission of traits.
• The continuity between the inert and the living, anticipating modern research on the origin of life.

Lamarck did not appeal to a creator God in his theory. His vision was materialistic and immanent: nature is explained by its own laws. If complexity increases, there must be a simple causal principle that originates it. This position places him, in many respects, closer to contemporary scientific materialism than Darwin himself, who retained theistic ambiguities and language laden with teleology.

3. Humboldt and the Systemic View of Nature

Alexander von Humboldt (1769–1859) developed in works such as *Cosmos* (1845–1862) a conception of nature as an interconnected whole. His approach was:

• Holistic: natural phenomena (climate, geology, vegetation, fauna, human cultures) form a network of causal relationships.
• Non-teleological: natural harmony does not require an external designer; it emerges from immanent laws.
• Aesthetic-cognitive: scientific understanding is enriched by the perception of the unity and beauty of the landscape.

Humboldt directly influenced the young Darwin, who learned from him to see nature as a mosaic of geographical patterns. However, his systemic approach was marginalized by the experimentalist reductionism that dominated 20th-century biology.

3.1 Humboldt's Contributions from a Contemporary Perspective

Humboldt's work is not a historical relic; it is an anticipated research program. His proposals resonate today in the most advanced fields of science:

• Complexity Sciences and Systems Theory: Humboldt was the first naturalist to treat nature as a self-regulating system of non-linear interactions. Current systems biology, which models metabolic and ecosystem networks, is a direct heir of his approach.
• Biogeochemistry and the Gaia Hypothesis: Humboldt demonstrated that climate, geology, and life shape each other. Today, James Lovelock and Lynn Margulis formalized this idea in the Gaia hypothesis, where life actively modifies

the atmosphere and the planet. The Anthropocene, as a geological era defined by human action on climate, validates Humboldt's warning that the destruction of one node of the network (deforestation, monoculture) alters the total system.
• Landscape Ecology and Biogeography: Humboldt invented the visualization of ecological data (the *Naturgemälde*, or "picture of nature"). His method of correlating altitude, temperature, humidity, and species distribution is the basis of current Geographic Information Systems (GIS) and computational climate models.
• Critique of Extractivism: Humboldt was the first scientist to denounce the link between colonialism, monoculture, and environmental degradation, documenting the ecological ravages of plantation agriculture in South America. Current agroecology and the critique of the Capitalocene reclaim him as an ecosocial thinker.

4. The Historical Triumph of Neo-Darwinism: Science and Ideology

Why were Lamarck and Humboldt displaced by the "single story" of Darwinism? The answer lies not solely in empirical evidence but in sociological, economic, and ideological factors.

4.1 Compatibility with Industrial Capitalism

The theory of "natural selection," especially in Herbert Spencer's version ("survival of the fittest"), offered a simple, competitive, and blind algorithm that resonated with the ideology of liberal Victorian capitalism. Nature as a "struggle for existence" legitimized economic competition, social hierarchy, and colonialism.

In contrast, Lamarck's view of plasticity and adaptive effort was less useful for justifying exploitation and inequality. Humboldt's vision of harmony and interconnection directly contradicted extractivist logic.

4.2 The Impact of the Lysenko Case

During the Cold War, the Soviet agronomist Trofim Lysenko was turned into the symbol of "communist pseudoscience." His rejection of Mendelian genetics and his defense of flexible heredity influenced by the environment were stigmatized by association with Stalinism. Thereafter, any mention of environmental heredity in the West became an academic taboo. Genetic Neo-Darwinism consolidated

as synonymous with rigor and scientific freedom, while Lamarckism was marginalized.

4.3 Genetic Reductionism as the Dominant Paradigm

The rediscovery of Mendel's laws and the development of population genetics allowed evolution to be mathematized as changes in gene frequencies. This approach offered precision, predictability, and formal elegance. Subsequent molecular biology, with DNA as the "master molecule," consolidated genetic determinism.

However, the decoding of the human genome at the beginning of the 21st century revealed the insufficiency of this model: barely 20,000–25,000 genes, a vast amount of non-coding DNA with regulatory functions, and the "missing heritability" for complex traits. Gene-centric reductionism entered a crisis.

5. The Refutation of the Darwinian Mechanism: Epigenetics and Systems Biology

As argued, the concept of "natural selection" is an anthropomorphic metaphor. Nature is not an agent that chooses, rewards, or punishes. What Darwin described as "selection" is, strictly speaking, a passive filter resulting from the physical, chemical, and ecological constraints of the environment. Contemporary biology must replace Victorian teleological language with systemic language.

Epigenetics studies heritable changes in gene expression that do not involve alterations in the DNA sequence. Mechanisms such as DNA methylation, histone modification, and non-coding RNAs allow the environment to leave a molecular mark that can be transmitted to offspring for one or several generations.

5.1 Transgenerational Epigenetic Inheritance

Cases have been documented in plants, animals, and humans:

• Effects of famine in mothers or grandparents on the metabolic health of subsequent generations.
• Transmission of learned fear of specific odors in mice, mediated by epigenetic marks in the olfactory system.
• Memory of cold, drought, or salinity stress in plants, which improves tolerance in offspring.

These findings do not validate the inheritance of acquired characters in the strict Lamarckian sense, but they do demonstrate that the environment can influence what is inherited, through molecular mechanisms that Lamarck could not have imagined.

5.2 Phenotypic Plasticity and Niche Construction

Evolutionary developmental biology (Evo-Devo) and niche construction theory have shown that organisms are not passive victims of the environment or their genes. Living beings:

• Actively modify their environment (niche construction).
• Exhibit phenotypic plasticity: the same genotype can produce different phenotypes depending on the environment.
• Can release cryptic variation under stress, revealing hidden adaptive possibilities.

These processes resemble Lamarck's intuition that behavior and the environment guide evolution, although through mechanisms different from those he proposed.

5.3 The Baldwin Effect

The Baldwin effect describes how behavioral plasticity can precede and facilitate the genetic fixation of adaptive traits. A behavioral change (e.g., adopting a new diet) creates new pressures that favor genetic variants that enhance that behavior, which can subsequently become canalized.

6. The Lysenko Case: A Critical Review

Trofim Lysenko has been presented as the epitome of pseudoscience. However, a rigorous analysis reveals a more nuanced reality.

6.1 Lysenko's Central Theses

1. Vernalization: treating seeds with cold to accelerate flowering. We now know this phenomenon is real and mediated by epigenetic changes in genes such as FLC.
2. Inheritance of environment-induced changes: Lysenko denied the gene as an immutable particle and argued that environmental stress could

readjust metabolism in a heritable way. Modern epigenetics has partially validated this intuition.
3. Selection under stress ("shock"): Lysenko held that subjecting plants to controlled stress released hidden variability that could be selected. This resembles the unmasking of cryptic variation mediated by proteins such as Hsp90.
4. Vegetative hybridization through grafting: he proposed that grafting could induce heritable changes. We now know that RNA and proteins move between graft and rootstock, and even horizontal gene transfer occurs.
5. Seed selection by vigor and maturity: empirical practices with a reasonable physiological basis.

6.2 The Double Historiographical Standard

Darwin is forgiven for his classism, sexism, and racism as "a child of his time." It is ignored that his ideas were used to legitimize colonialism, eugenics, and ultimately the Nazi Holocaust. Watson and Crick are considered founders of molecular genetics despite their ignorance of epigenetics and complex gene regulation.

Lysenko, on the other hand, is condemned as a "bad geneticist" without recognizing that he did not pretend to be one: he rejected the gene as a unit and proposed a physiology of the organism based on the integrity of the living being and its interaction with the environment.

6.3 Political Responsibility and Scientific Judgment

It is undeniable that Lysenko persecuted geneticists with opposing ideas, such as Vavilov, who died in prison. That was a political and moral crime that must be condemned. But ethical condemnation does not automatically invalidate his biological intuitions. Science does not operate by moral judgments but by empirical evidence.

7. Toward an Extended Evolutionary Synthesis: Overcoming Darwinism

21st-century biology faces the challenge of integrating discoveries that gene-centric reductionism could not explain. The extended evolutionary synthesis proposes to incorporate:

1. Epigenetic inheritance: the transmission of information beyond DNA.
2. Phenotypic plasticity: the ability of a genotype to produce multiple phenotypes depending on the environment.
3. Niche construction: the active modification of the environment by organisms.
4. Symbiogenesis: evolution through fusion and cooperation between organisms, not only through competition.
5. Development as an evolutionary driver: ontogeny is not a mere unfolding of genetic instructions but a creative process that generates novelty.
6. Intentionality and agency: organisms are not passive automata; they explore, choose, and modify their environment.

This synthesis abandons the concept of "natural selection" as an operational metaphor. Nature does not select. Evolution results from the self-organization of complex systems, genetic drift, passive physical pressures, phenotypic plasticity, and ecological interactions. To say that evolution is driven by a "blind selector" is to perpetuate a Victorian metaphor laden with theological teleology.

8. Conclusion

The history of evolutionary biology is not a straight line of inevitable progress from ignorance to truth. It is a battlefield where paradigms, ideologies, and interests clash. Lamarck, Humboldt, Darwin, and Lysenko were all pioneers who worked within incomplete conceptual frameworks. None should be deified or demonized. Contemporary epigenetics, systems biology, and agroecology have inadvertently rescued fragments of truth that Neo-Darwinism had buried. The goal is not to resurrect classical Lamarckism or to politically rehabilitate Lysenko. It is to build a biology that recognizes the complexity of life: a biology where the environment leaves its mark, where plasticity guides evolution, where cooperation matters as much as competition, and where organisms are active agents in their own becoming. Science does not advance through hagiographies or political tribunals. It advances when it dares to question its own dogmas and listen to the voices that the official narrative silenced.

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